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Information Science and Technology Center Seminar Series

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"Nonlinear Systems Analysis tools using Sum of Squares"

Wednesday, March 30, 2011
3:00 - 4:00 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: The use of Linear Matrix Inequality and Semidefinite Programming techniques is very common in modern control systems analysis and design. At the same time, positive polynomials can help formulate a large number of problems in robust control, non-linear control and non-convex optimization – consider, for example, the use of Lyapunov functions for stability analysis of equilibria of nonlinear dynamical systems. The fact that polynomial positivity conditions can be formulated efficiently in terms of Linear Matrix Inequalities opens up new directions in nonlinear systems analysis and design.

In this talk I will first present how ideas from dynamical systems, positive polynomials and convex optimization can be used to analyze the stability, robust stability, performance and robust performance of systems described by nonlinear ODEs. I will also discuss briefly how hybrid/switched systems and time-delay systems can be analyzed before describing how other, more interesting analysis questions can be answered using these tools.

This approach for systems analysis, although entirely algorithmic, is currently not scalable to large system instances. To address this, I will first consider the analysis of large-scale networked systems and discuss how the system structure (both the dynamics at the nodes and the topology of the underlying network) can help generate robust functionality conditions that scale with the system size. I will finally talk about some of the most recent work on how to analyze “medium-sized” dynamical systems, combining ideas from graph partitioning and the theory of interconnected systems.

Biography: Antonis Papachristodoulou received an MA/MEng degree in Electrical and Information Sciences from the University of Cambridge, UK, in 2000, as a member of Robinson College. In 2005 he received a Ph.D. in Control and Dynamical Systems, with a minor in Aeronautics, from the California Institute of Technology. In 2005 he held a David Crighton Fellowship at the University of Cambridge and a postdoctoral research associate position at the California Institute of Technology before joining the Department of Engineering Science at the University of Oxford, UK in January 2006, where he is now a University Lecturer. His research interests include scalable analysis of nonlinear systems using convex optimization based on Sum of Squares programming, analysis and design of large-scale networked control systems with communication constraints and Systems and Synthetic Biology.

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For more information contact the technical host Marian Anghel, manghel@lanl.gov, 667-9470 or Frank Alexander, fja@lanl.gov, 665-4518. If you wish to schedule an appointment with Dr. Papachristodoulou please contact Josephine Olivas, jojo@lanl.gov, 663-5725.
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